IN CONCLUSION

This progress report, involving 9,527 cases with an age range of from under three to forty years and over, is an indication of the importance of this often neglected activity in any department of public health program. The fact that in the majority of cases the age range was from six to eighteen years points to a concentration of effort in the age groups where the best results are generally obtained. It may be of interest to note that, of the total number of cases that were studied (9,527), there were 1,554, or 16 per cent, classified as feeble-minded. This brings up the age-old question of the possibility of the elimination of feeble-mindedness without the actual elimination of the feeble-minded. The San Francisco Department of Public Health has proceeded on the hypothesis that a diagnosis of feeble-mindedness once made should not necessarily mean an absolutely incurable condition. It is fully recognized, however, that deficiencies in brain tissue can never produce a normal mentality. Moreover, the cases regarded as due to inherited defects bring up another moot question of the prevention of the birth of additional children from the original parents. And, furthermore, humanity demands that, once born, a child so mentally handicapped must live, and must be adequately trained or controlled. To be effective, therefore, the application of modern methods of mental hygiene as a public health procedure must begin early in order that a distinct menace to society may be scientifically and humanely obviated. It is of interest to note that 4,237 cases, or approximately 44 per cent of the total number examined, were classified as normal or superior.

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ANESTHETICS: A PLEA FOR AN ACCURATE RATING*

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THE number of anesthetic agents and methods of anesthesia is so great that it becomes increasingly difficult for many of us to appraise their respective values.

If we inquire about the new procedures or new chemical compounds in use as anesthetics at different hospitals, the replies received are often diametrically opposed.

Some of the older men, who were brought up to the use of ether, still consider that to be entirely satisfactory in every case. Younger men, who have studied spinal anesthesia, believe that to be the best method in all of their cases. Anesthetists who are familiar with nitrous oxid may say that it is the perfect anesthetic. Manufacturers and advertising concerns add to the confusion by putting on the market new drugs which in glowing reports are highly praised, while little or nothing is said about their objectionable features.

We need a method (a yardstick, so to say) by which we may express the value of a given anesthetic by a certain figure representing the sum of its virtues and faults, so that all these drugs can be quickly and easily compared.

For some time past I have attempted to make such an appraisal for my own guidance. Using a mark of 10 for excellent and 0 for very poor, I have tried to determine how each method of anesthesia measures up to certain fundamental requirements or postulates such as *safety, efficiency, comfort,* and *cost.* I have then subdivided each of these main headings into several parts in such a way that safety counts for five units, efficiency for three, comfort for one, and cost for another one unit.

It is true that my figures may have little value to anybody but myself, as they represent the opinion of one person only. If, however, the problem could be submitted in the form of a questionnaire to one hundred or two hundred anesthetists, and their replies tabulated, the averages reached would, I believe, represent a fairly accurate objective—we might say, "official" rating—by the medical profession, of the various methods of anesthesia.

In the table appended, I have tried to estimate the value of various anesthetics judged by certain standards which are considered to be the indispensable and essential postulates of anesthesia.

SAFETY

1. *The possibility of instant withdrawal of the anesthetic in case of danger* is one of the fundamental requisites of anesthesia, inasmuch as all anesthetics and soporifics are poisons—potentially at least—and accidents can never be ruled out. The inhalation anesthetics are the only ones which give complete satisfaction under this heading.

2. The *margin of safety* is represented by the amount of anesthetic necessary to carry the patient from the third stage of anesthesia (suppression of reflex sensibility) to the fourth stage (paralysis of the bulb and death). This margin is very small in the case of chloroform, for instance, but is wide for some other agents.

3. Under *injurious effects* we group such accidents as primary inhibition of the heart, asphyxia, secondary degeneration of the viscera, spasm or catarrh of the intestine, and so forth.

4. To obtain an index of the *absence of fatalities,* it is necessary to know the number of deaths in a series of administrations of a given anesthetic. If the figure is, say, two deaths in 10,000 administrations of ether, drop the three zeros and take the inverse figure (10-2-8) as the index. Thus, for ether, 8 is the index for the absence of fatalities in 10,000 administrations.

5. The *absence of inflammability or explosibility* is self-explanatory.

EFFICIENCY

6. *Suppression of the conscious sensibility,* by which we mean, not the patient's physical com-

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EVALUATION OF ANESTHETICS UNDER VARIOUS HEADINGS

LEGEND
10 = excellent
0 = very bad

		A. GENERAL ANESTHESIA: α BY INHALATION — I Inhalation plus some opiate						A. GENERAL ANESTHESIA: α BY INHALATION — II. Inhalation (N_2O + O) plus some powerful adjuvants				A. GENERAL ANESTHESIA: β BY OTHER METHODS			B. LOCAL ANESTH.	B. CONDUCTION ANESTHESIA (NERVE BLOCK) Plexus anesth, Paravertebral, Parasacral, Caudal, Transsacral, Splanchnic	C. SPINAL ANESTH.
		The ideal anesthetic	Ether	N_2O+O	Ethylene	Cyclopropane	Chloroform	Paraldehyde	Avertin	Barbiturates	Hyoscin (hypodermically)	Rectal Ether	Intravenous Hedonal, Evipal, Isopral	Subcutaneous Hyosein	Procain (local)	Procain (regional)	Neocaine, spinocaine, etcetera
SAFETY	1. Possibility of instant withdrawal in case of danger	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0
	2. Margin of safety	10	9	9	8	8	2	9	8	6	5	7	3	1	6	6	5
	3. Absence of primary or after effects (on lungs, heart, liver, kidneys, intestines) and counter indications	10	5	10	10	10	4	9	9	9	9	8	7	6	9	9	7
	4. Absence of fatalities	10	8	9	9	9	5	9	8	8	7	9	5	2	9	9	5
	5. Absence of inflammability (explosibility)	10	2	10	0	0	10	10	10	10	10	1	10	10	10	10	10
EFFICIENCY	6. Suppression of conscious sensibility (syncope, psychic shock, etcetera)	10	10	10	10	10	10	10	10	10	10	9	9	9	0	0	0
	7. Suppression of reflex sensibility (especially rigidity of the abdominal muscles) and duration of the anesthesia	10	10	3	7	7	10	8	8	6	6	8	2	3	6	7	10
	8. Ease of administration even with moderate skill	10	9	4	6	6	5	4	4	5	5	7	9	10	8	6	7
COMFORT OF THE PATIENT	9. Avoidance of apprehension or mental strain, choking sensation, (odor) nausea, vomiting, headache, etcetera	10	5	9	8	8	7	9	9	9	9	6	9	9	6	5	5
COST	10. Inexpensiveness	10	9	2	6	6	9	3	3	3	3	9	9	10	8	8	9
	RATING	100	77	69	74	74	72	71	69	66	64	64	63	62	62	60	58

fort—as mentioned under 9—but his lack of consciousness of the operation is most desirable. In achieving this result, the inhalation anesthetics stand out conspicuously among all others.

7. *Suppression of the reflex sensibility and rigidity,* especially of the abdominal muscles, is the great unsolved problem of surgical anesthesia for laparotomies. The surgeon who is fearful of the bad effects of ether in prolonged operations is forced to resort to various procedures, some of which clearly violate the principles laid down under 1 and 6, and, in addition, are often quite unsatisfactory in other respects.

8. *Ease of administration* makes it possible for an anesthetic to be given in remote districts, in the rear of battlefields, on board ships, etc., by doctors or attendants not highly trained in anesthesia. This feature adds much to the efficiency of an anesthetic available in such situations.

COMFORT

9. The *comfort of the patient* certainly should not be ignored if it may be had without undue risks, which, unfortunately, is not always the case.

COST

10. Nor should the *cost* of an anesthetic be forgotten entirely, but instead be completely subordinated to the considerations of safety and efficiency.

EVALUATION AND "RATING"

If we try to analyze and interpret the figures given in the table, we find the following as facts:

A. GENERAL ANESTHESIA

1. Inhalation anesthetics, with the addition of some opiate, obtain a rating of from 72 to 77.

Their advantages are the possibility of instant withdrawal in case of trouble, and complete suppression of consciousness; also the margin of safety and the absence of fatalities are fair (with the exception of chloroform). In some of these agents, however, we find very bad features in their after-effects, inflammability, rigidity of the muscles, discomfort of the patient, cost, and so forth.

2. Inhalation anesthesia (mostly nitrous oxid and oxygen, combined with some powerful adjuvant) has a rating of from 64 to 71.

This method gives a little more comfort to the patient and, since it reduces the amount of general anesthetic, has fewer bad effects than the pure inhalation anesthetics; the suppression of conscious sensibility is satisfactory; also there is no danger of inflammability. The powerful drugs once given, however, cannot be withdrawn at will; the margin of safety is not good (except for paraldehyd) and some fatalities have been reported. The suppression of reflex sensibility is not always satisfactory, which means that ether may have to be added; the administration is not easy and the cost is high, as nitrous oxid with oxygen is used throughout.

3. General anesthesia, without inhalation, by the rectal, intravenous, or subcutaneous routes, has a rating of between 62 and 64.

These procedures are (with the exception of ether administered rectally) comparatively com-

fortable to the patient, the expense is small and the administration easy. There is no inflammability (except for ether) and the suppression of conscious sensibility is good. On the other hand, the drugs once given cannot be withdrawn; the margin of safety is small; there have been fatalities (due to idiosyncrasies ?), and there have been some bad after-effects on the heart; also the reflex sensibility is not always sufficiently suppressed.

B. LOCAL AND CONDUCTION ANESTHESIA

These methods, with a rating of from 60 to 62, have no after-effects to speak of and very few fatalities; there is no inflammability to be feared, and the cost is low. The drawbacks are that, once given, the drug cannot be withdrawn; the margin of safety is within narrow limits; the patient remains conscious; the reflex sensibility and the sensation of pain are not always absent, and there have been cases of psychic shock. In addition, the anesthesia may wear off before the operation is complete. Conduction anesthesia is cumbersome and there are a good many failures. On the whole, the comfort of the patient is not the best.

C. SPINAL ANESTHESIA

Spinal anesthesia has a rating of 58. This is the most successful of all procedures for doing away with all muscular rigidity, and there is no fear of inflammability. It has many defects, however: the drug cannot be withdrawn in case of accident; the margin of safety is very small; there are several contra-indications, and bad effects and fatalities occur now and then.

The patient is conscious throughout the procedure and this must cause him great mental distress, as laparotomies are long and serious operations. It is true that technique has been improved greatly of late, and we must admit certain clear indications for this method as the lesser evil in some situations. But, on the whole, it is the least humane of all procedures, and most surgeons consider it a method of exception.

COMMENT

The foregoing findings lead to certain definite conclusions: First of all, it is surprising that, after using surgical anesthesia for nearly a century, we possess no anesthetic which rises above a rating of 77. Many of these agents may be called good or fair, but none can be said to be perfect or even excellent, and the ideal anesthetic with an index of 100 is still unknown.

As we found perfection unattainable, the administration of anesthetics has been split into about thirty different methods, each supposed to correspond to some special indication or contra-indication, and it is undeniable that great progress has been achieved. New procedures or new anesthetics are introduced constantly, but they all have one thing in common: on one side they show some improvement; on the other, they come to us with some objectionable feature. The question thus arises, have we made real progress or are we not simply exchanging a poor article for another that is almost equally mediocre? Why do the chemists and manufacturers insist on putting on the market new anesthetics which so infringe on the fundamental postulates of anesthesia and have such glaring defects—such as toxicity, lack of relaxation, explosibility, and so forth—that, after a few years' trial, are discarded by most of us?

Is there no other direction in which a more decisive advance can be made? Here and abroad are many large firms which maintain staffs of the best chemists of the world. These men have given us artificial silk, synthetic rubber, the terrible explosives of modern warfare, asphyxiating gases, many synthetic drugs and the like, and the question arises: Is it not possible for the science of chemistry to create, by synthesis or otherwise, a more satisfactory anesthetic—one that would combine all the advantages of the others and eliminate their faults? Could not these chemists, for instance, add a "radical" to cyclopropane so as to do away with its inflammability?

Some may think this idea visionary and impossible of realization. Yet we have before our eyes the brilliant achievement of the chemists who gave us novocain, and the story of local anesthesia certainly sounds like a dream come true. Some eighty years ago cocain was introduced and from it surgeons learned what a local anesthetic should not be. In their minds they constructed the ideal drug for local anesthesia—one that would be a good analgesic, of low toxicity, easily soluble in physiologic solution, resistant to boiling, noninjurious to the tissues, and so forth. At their request a chemical genius applied himself to the task of producing this ideal local anesthetic. The molecule of cocain was split; the "elements" or "radicals" that were harmful or useless were eliminated. Other valuable groups or radicals were added. It took thirty years of continuous experimentation; but finally we received novocain, a synthetic drug, which stands as a monument to the will and creative power of the human mind.

Let us hope, then, that, in the search for an ideal general anesthetic, synthetic chemistry will some day repeat the triumph it achieved with the discovery of novocain.

First of all, however, medical men should know what they want. If we had, for all anesthetics, official ratings laid down by a college of anesthetists, we could, with these figures, go to the chemists and manufacturers, point out to them the faults that should be corrected and the good qualities that should be enhanced, and give them definite specifications of what we consider a satisfactory anesthetic. With this data in hand, the medical profession could exert a firm pressure and refuse to accept any anesthetic that is put on the market with defects that violate the fundamental requisites of anesthesia. This should spur the chemists and manufacturers to renewed and greater effort until they would be able to give us a really perfect anesthetic that will satisfy all the postulates of *safety, efficiency, comfort,* and *cost.* We call on the fraternity of anesthetists to take the lead in this work!

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